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plane, and let z'_1, z'_2, z'_3 represent the corresponding vertices in a z' -complex-number-plane.

A transformation can always be found that will change z_1 in z'_1 , and z_2 into z'_2 . For this it is sufficient that a and b in

$$\left. \begin{aligned} z'_1 &= az + b \\ z'_2 &= az_2 + b \end{aligned} \right\} \dots (1),$$

shall satisfy the condition

$$a = \frac{z'_2 - z'_1}{z_2 - z_1}, \text{ and } b = \frac{z'_1 z_2 - z'_2 z_1}{z_2 - z_1}.$$

Every transformation of the plane into itself that leaves every figure in the plane similar to itself is expressible in the form

$$z' = az + b \dots (2).$$

The value of a and b in (1) must satisfy the equation $z'_3 = az_3 + b$. For this the necessary and sufficient condition is

$$\frac{z'_3 - z'_1}{z_3 - z_1} = \frac{z'_2 - z'_1}{z_2 - z_1}; \therefore \begin{vmatrix} z'_1 & z_1 & 1 \\ z'_2 & z_2 & 1 \\ z'_3 & z_3 & 1 \end{vmatrix} = 0.$$

The conditions that the sides shall be equal are

$$\frac{z_1 - z_2}{z_2 - z_3} = \frac{z_2 - z_3}{z_3 - z_1} = \frac{z_3 - z_1}{z_1 - z_2}; \therefore \begin{vmatrix} z_1 & z_2 & 1 \\ z_2 & z_3 & 1 \\ z_3 & z_1 & 1 \end{vmatrix} = 0.$$

Also demonstrated by WILLIAM HOOVER, G. B. M. ZERR, J. W. YOUNG, and J. SCHEFFER.

CALCULUS.

108. Proposed by JOHN M. COLAW, A. M., Monterey, Va.

The hypotenuse of a plane right triangle increases uniformly at the rate of 1-12 of an inch a second. If the legs are as 2 to 3, at what rate is the area of the triangle increasing when the perpendicular from the right angle upon the hypotenuse is 12 inches?

Solution by C. HORNING, A. M., Heidelberg University, Tiffin, O.; H. C. WHITAKER, Ph. D., Manual Training School, Philadelphia, Pa.; J. W. YOUNG, Cornell University, Ithaca, N. Y.; P. S. BERG, Larimore, N. D.; and D. G. DORRANCE, Jr., Camden, N. Y.

Let x = the length of the hypotenuse, and y = the area.

Then $dx = \frac{1}{12}$, and dy is required when the perpendicular from the right angle to the hypotenuse equals 12.

From the condition of the problem $y = \frac{3x^2}{13}$, whence $dy = \frac{6x dx}{13}$.

Now when the perpendicular from the right angle to the hypotenuse is 12 the hypotenuse must be 26. Hence, substituting in the last equation we have $dy = \frac{6 \times 26 \times \frac{1}{2}}{13} = 1$; i. e., the area, at the time mentioned, is increasing at the rate of 1 square inch a second.

Also solved by *L. B. FILLMAN, ALOIS F. KOVARIK, J. SCHEFFER, C. D. SCHMITT, and G. B. M. ZERR.*

109. Proposed by *M. E. GRABER*, Heidelberg University, Tiffin, Ohio.

Find the curve in which the product of the perpendiculars drawn from two fixed points to any tangent is constant.

Solution by *COOPER D. SCHMITT, A. M.*, Professor of Mathematics, University of Tennessee, Knoxville, Tenn., and the PROPOSER.

Let the equation of the tangent be

$$y - y' = \frac{dy'}{dx'}(x - x').$$

And let the two points be $(a, 0)$ and $(-a, 0)$.

The product of the two perpendiculars is easily found to be

$$\frac{(x dy - y dx)^2 - (a dy)^2}{(dx)^2 + (dy)^2} \text{ which } = b^2,$$

$$\text{or } \frac{(xp - y)^2 - (ap)^2}{1 + p^2} = b^2, \text{ or } (xp - y)^2 = p^2(a^2 + b^2) + b^2,$$

$$\text{or } y = px \pm \sqrt{[p^2(a^2 + b^2) + b^2]}.$$

This is Clairaut's form, so that we have

$$y = mx \pm \sqrt{[m^2(a^2 + b^2) + b^2]},$$

which is the well-known tangent to an ellipse.

Also solved by *H. C. WHITAKER*, and *G. B. M. ZERR.*

MECHANICS.

108. Proposed by *F. P. MATZ, M. Sc., Ph. D.*, Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pa.

Can it be shown, as a result of Kepler's third law, that the distances are inversely proportional to the squares of the velocities?

Solution by *G. B. M. ZERR, A. M., Ph. D.*, Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

This can be demonstrated for circular orbits as follows: